

**USNA-203**

**Space Communications  
International Educational  
Network ...  
Classroom Experience**

**S.C.I.E.N.C.**

**E.**

**Navy SERB: 28 Aug**

**2002**

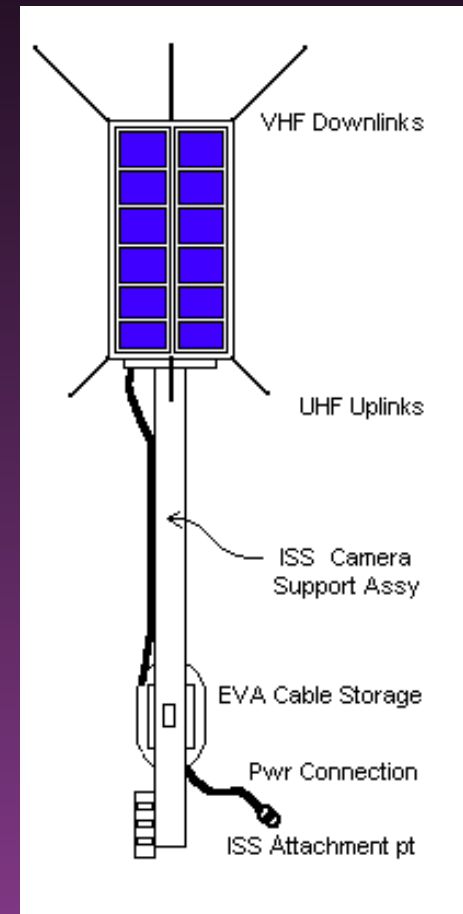
**Lt Col Billy R. Smith, Jr.,**

**USAF**

**USNA Small Satellite**

**Program**

**(410) 293-6410**



# Concept

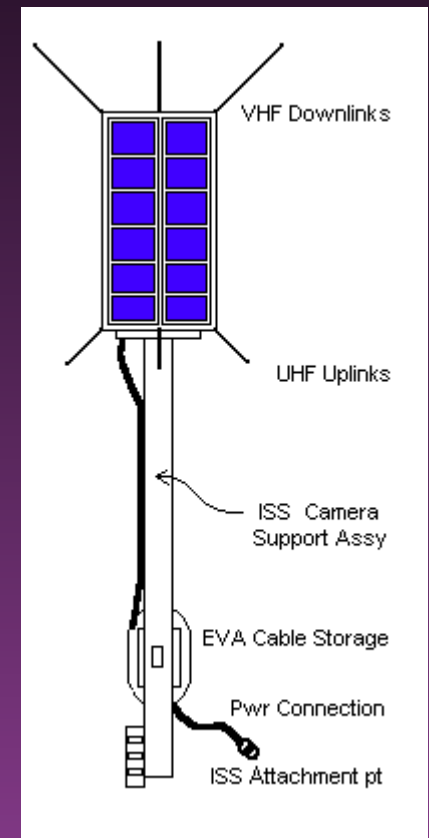
## OBJECTIVE:

Education of future Naval Officers in Space Programs and Technology  
Practical hands-on experience for other DOD personnel

- DOD/NASA Partnering => Order of magnitude enhancement of existing ISS Educational and Outreach program (ARISS)

## HARDWARE DESCRIPTION:

- External ISS attached 50 kG autonomous payload
  - Attached-to/powerd-by external Camera Support Assy
  - Multimode Xsponders: Voice, TLM, Video, Image, Data
- School Ground Stations:
  - Off-the-shelf, low-cost (\$100 to \$200) transceivers
  - Downloadable software defined sound-card modems



## MILITARY RELEVANCE:

- **Education of Midshipmen in Space Applications**
  - Both Hardware Design and Program Management
  - Ref: USSpaceCom Long Range Plan, p. 73, 77-79.
- **DOD Educational Institutions:** Service Academies (3)  
Graduate Institutions (3+)  
ROTC Units (550 Schools)
- **DOD Auxilliary Comms Cadre:** Civil Air Patrol (1800 units)  
Military Affiliate Radio Stations (tbd)  
US Coast Guard Auxilliarries (33,000)

**NEED FOR SPACE FLIGHT:**      **The medium is the message**

**COMPARISON TO ALTERNATIVES:**      **Expands on SAREX / MIREX /  
ARISS**

# Detailed Overview

## FLIGHT DATA

- Attached ISS payload = Any orbit
- Omni Antennas = Any attitude
- Design Life  $\geq$  5 years
- Power  $\leq$  100W. (10W minimum)
- Simple Crew interface (3 on/off switches)

## STATUS

- Concept Design Phase
- Partnering with other Institutions
- Vast volunteer support system (AMSAT)
  - 46+ satellite track record
  - Shuttle, MIR, ISS experience

## FLIGHT MODE SUITABILITY: STATION only

## PRIORITY: New Effort

## REQUESTED STP SERVICES:

- ✓ Launch Services
- ✓ Launch Integration

## EXPERIMENT FUNDING:

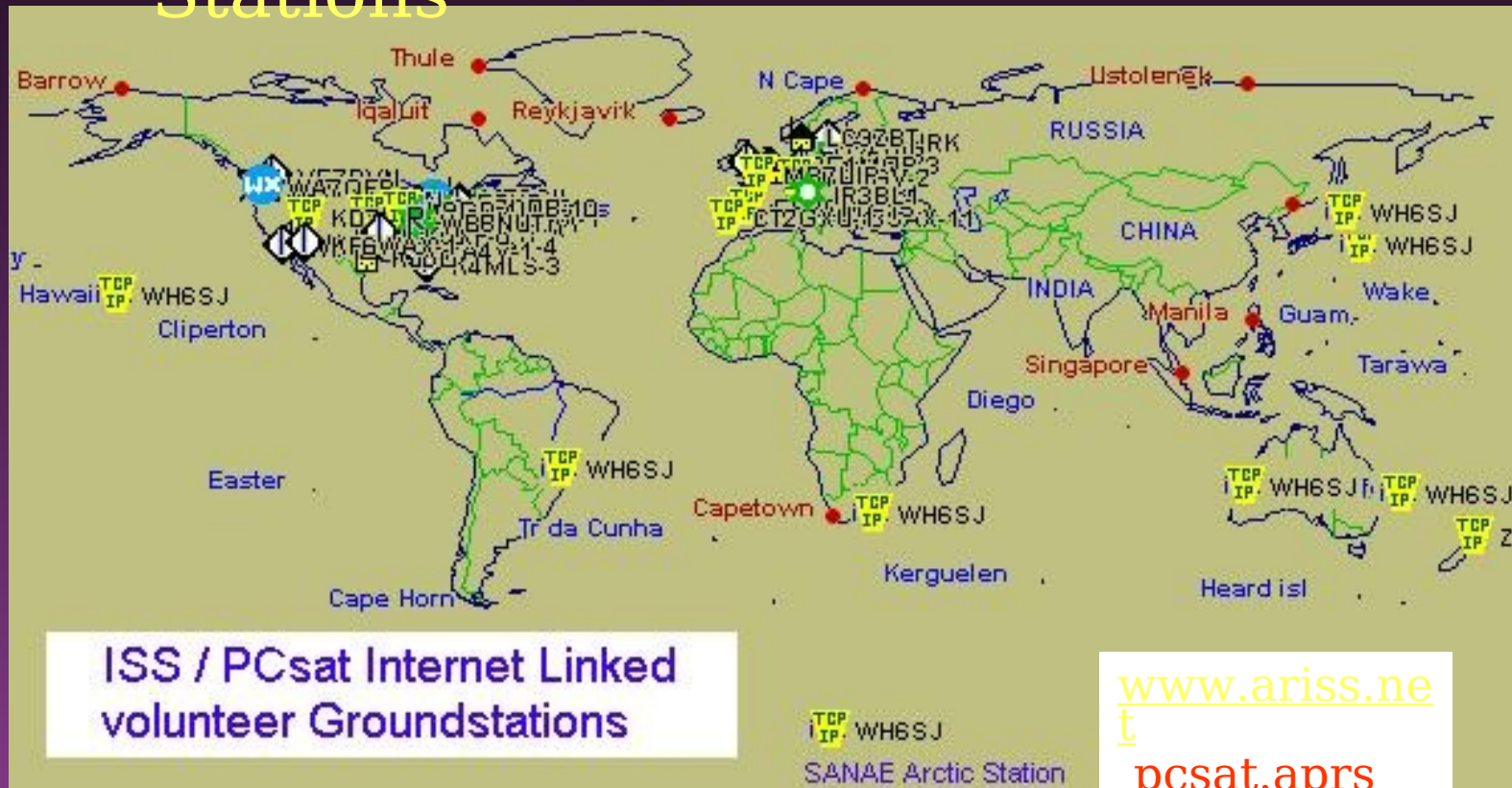
- ✓ USNA \$25K / yr Boeing Grant
- ✓ Partnering
  - NASA/ARISS TBD
  - AMSAT TBD
  - Other Universities TBD
  - Other DOD TBD

	Prior	FY03	FY04	FY05
Req't	\$0K	\$25K	\$25K	\$25K
Actual	\$0K	\$25K	\$25K	\$25K

## SPACE

# Summary of Data Application

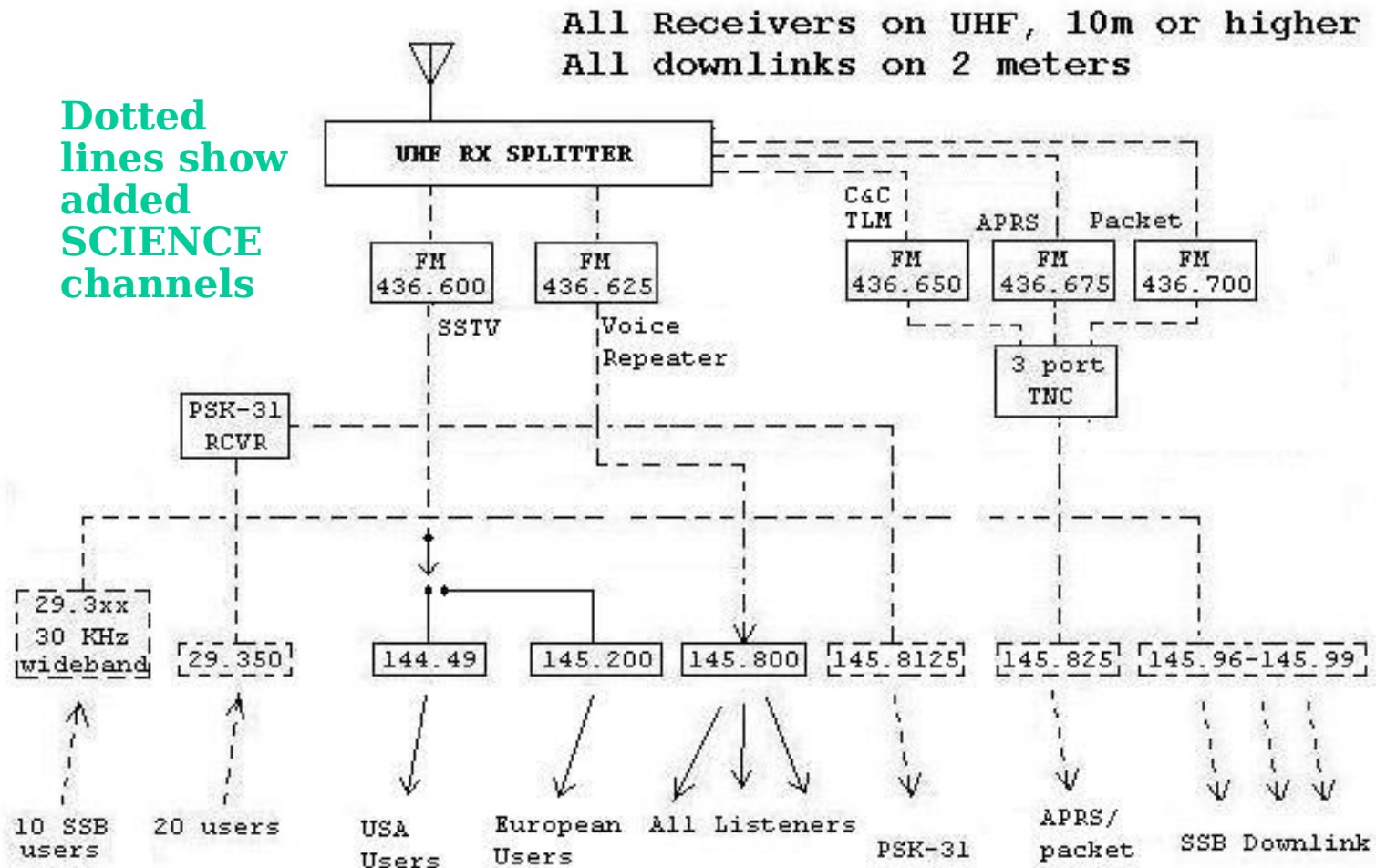
All downlinks available live on web via  
Participating internet linked Ground  
Stations



[www.ariss.net](http://www.ariss.net)

[t.pcsat.aprs.org](http://t.pcsat.aprs.org)

WB4APR





# Background

- *Since 1983, organizations in the U.S. (SAREX), Germany (SAFEX) and Russia (MIREX), have worked with the space agencies to fly amateur radio and to support Educational Outreach on:*



•Space Shuttle

ARIS  
S•ISS



•Mir

**Future:  
S.C.I.E.N.C.  
E**

# Outreach Objectives



- Spark Student's Interest
- Crew Family Contacts
- Promote Interest
- In Science & Technology
- (Crew Psychological Ops)
- In Amateur Radio



- Human Spaceflight
- Awareness



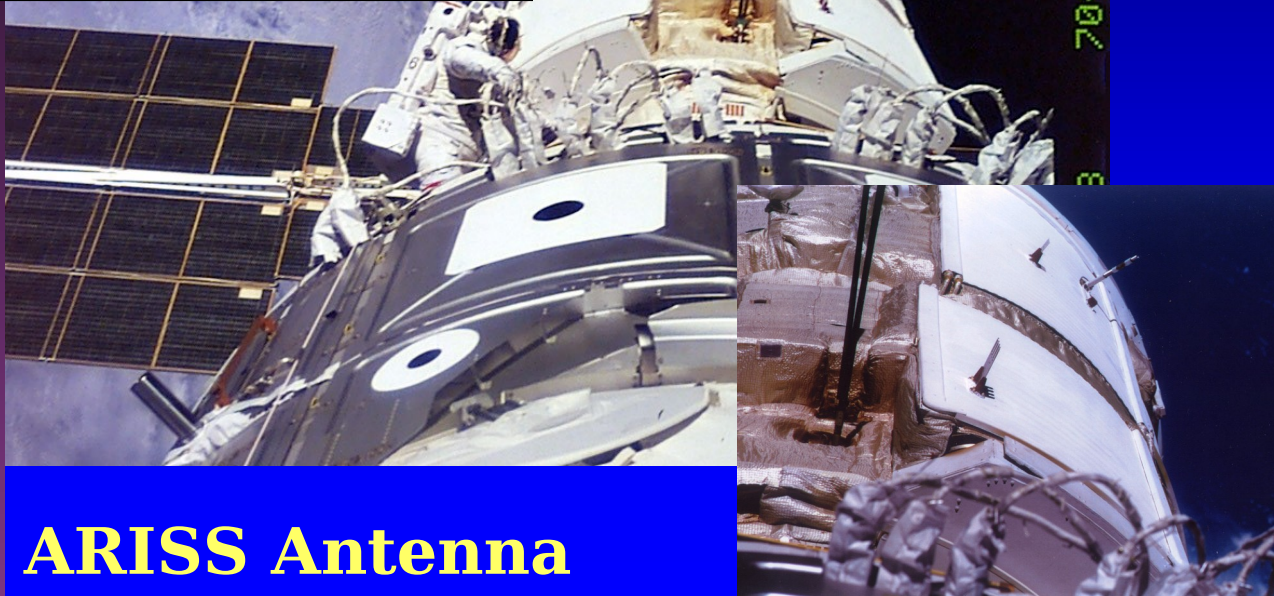
Mfr: SGTV  
Date: 12-99 14:49 UTC Rev: W8ZGF

- Experimentation



# NASA Commitment

**NASA is strongly  
invested in  
ARISS/Educational  
and Outreach  
objectives**



**ARISS Antenna  
EVA's**

**USNA-0203 Space Com Intl  
Educational Network -  
Classroom Experience -  
SCIENCE**

# **ISS Crew using ARISS**



**Data  
&  
Voice**



**250  
contacts in  
24 hrs**



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**SCIENCE**

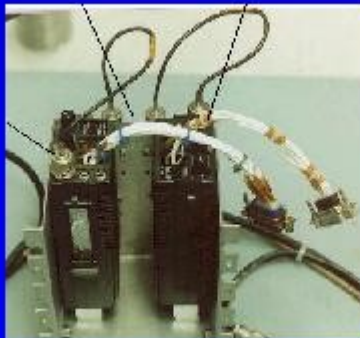
# Multimode Capabilities

**Video, Image, Telemetry, Data,  
Experimental Modes, Low Bandwidth  
high user multiplexing**



## **Amateur TV**

(Standard, Spread  
spectrum, & MPEG)



**R/T Internet TLM  
using amateur radio**

**Express Pallet---**  
**External payloads w/  
antennas & student  
experiments**

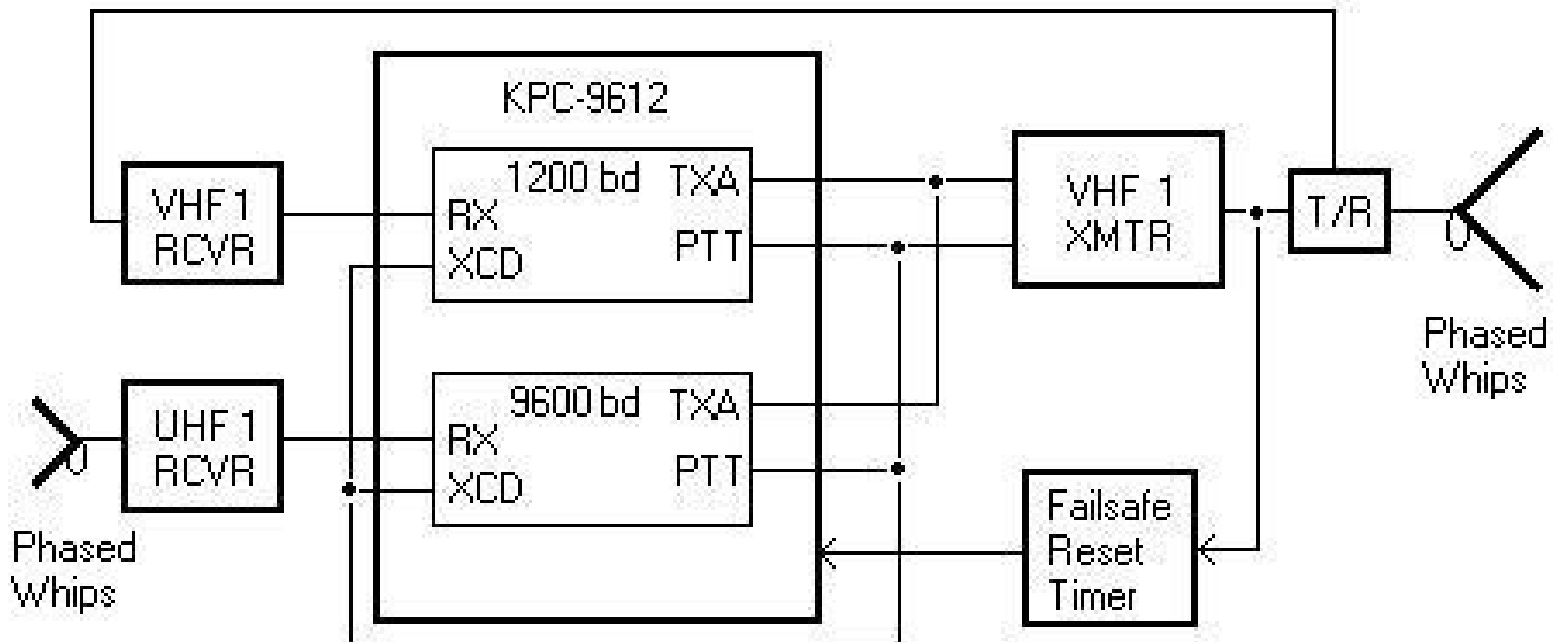
**Here's  
where we  
fit in.**

# Electrical Power Budget

* SYSTEM	FIXD	TX-RF	duty	Effcy	TX-DC	total
* -----	----	-----	----	-----	-----	-----
* Voice repeater	1W	5W	100%	33%	15W	16W
* Packet Digipeater	2W	5W	40%	33%	6W	8W
* SSTV repeater	1W	5W	70%	33%	10W	11W
* PSK-31 repeater	1W	5W	100%	33%	15W	16W
* Wideband Xponder	1W	2W	80%	33%	8W	9W
* Control system	1W					1W
* Reg/distriubtion				70%		7W
* Charging losses			45%	70%		12W
* -----						-----
* Total						80w



## PCsat Xponder for Position/Status/Message Relay



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# PCsat DOD Synergy

## PCsat Data Experiment in F-16 Aircraft

Rome Air  
Development  
Center



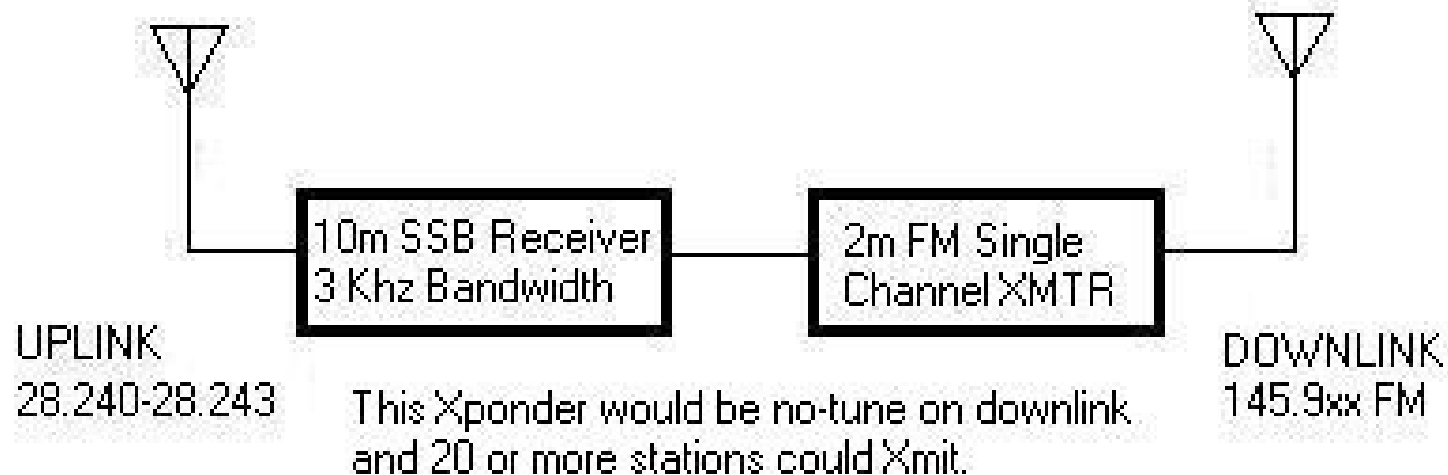
Palm Pilot APRS display  
running PalmAPRS

# 20+ Simultaneous Users

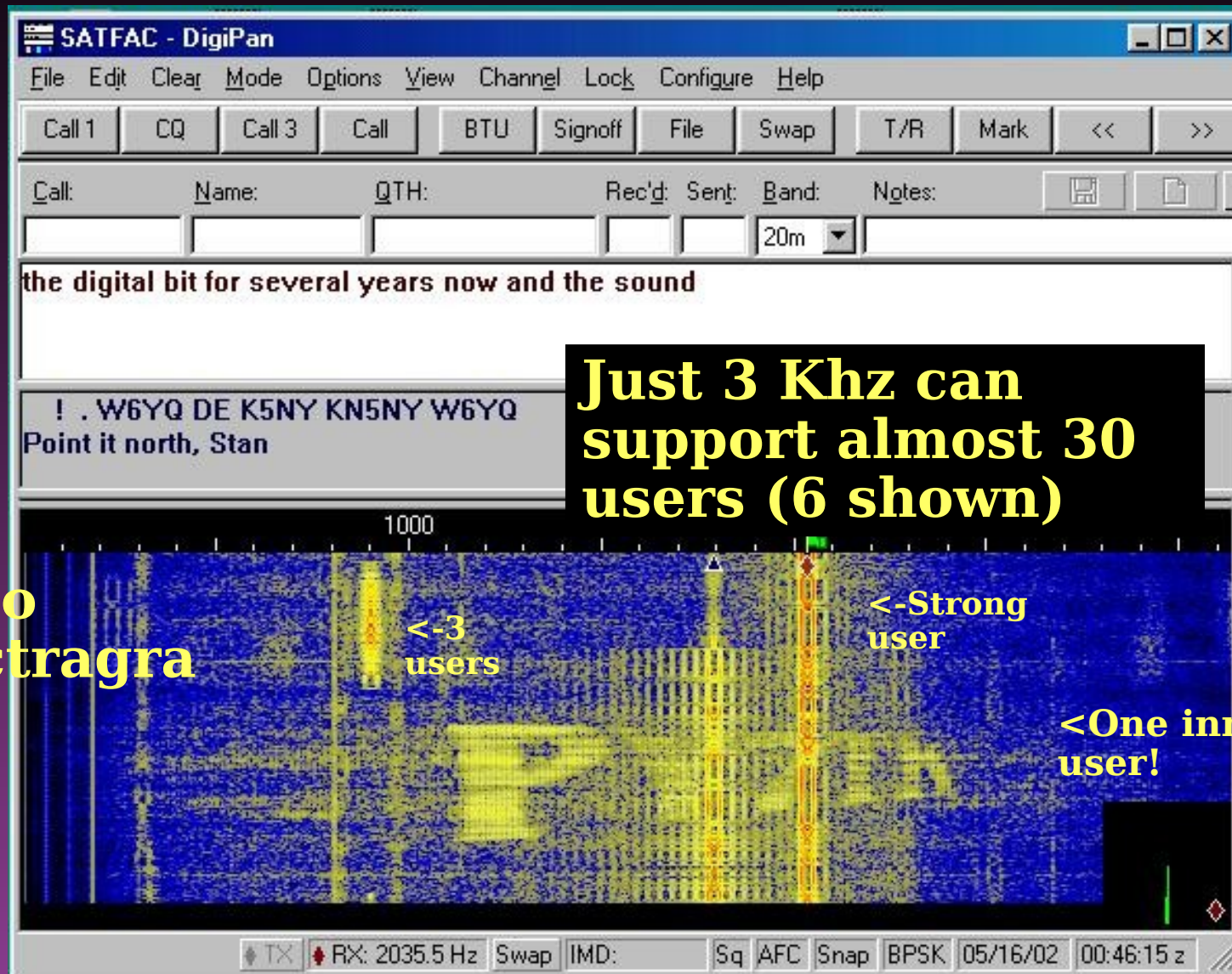
**Solves number 1 ARISS problem:**  
**CONTENTION!**

**Uplink**

## PSK-31 SSB=>FM Transponder



# PSK-31 Narrowband



**Just 3 Khz can  
support almost 30  
users (6 shown)**

**Audio  
Spectra  
m**

**<-3  
users**

**<-Strong  
user**

**<One innovative  
user!**



# Live-Direct Video/Imaging



“Joey,  
let me  
send  
you a  
picture  
!”



“Here’s  
what we  
see out  
the  
window  
”



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# Minimum School Station



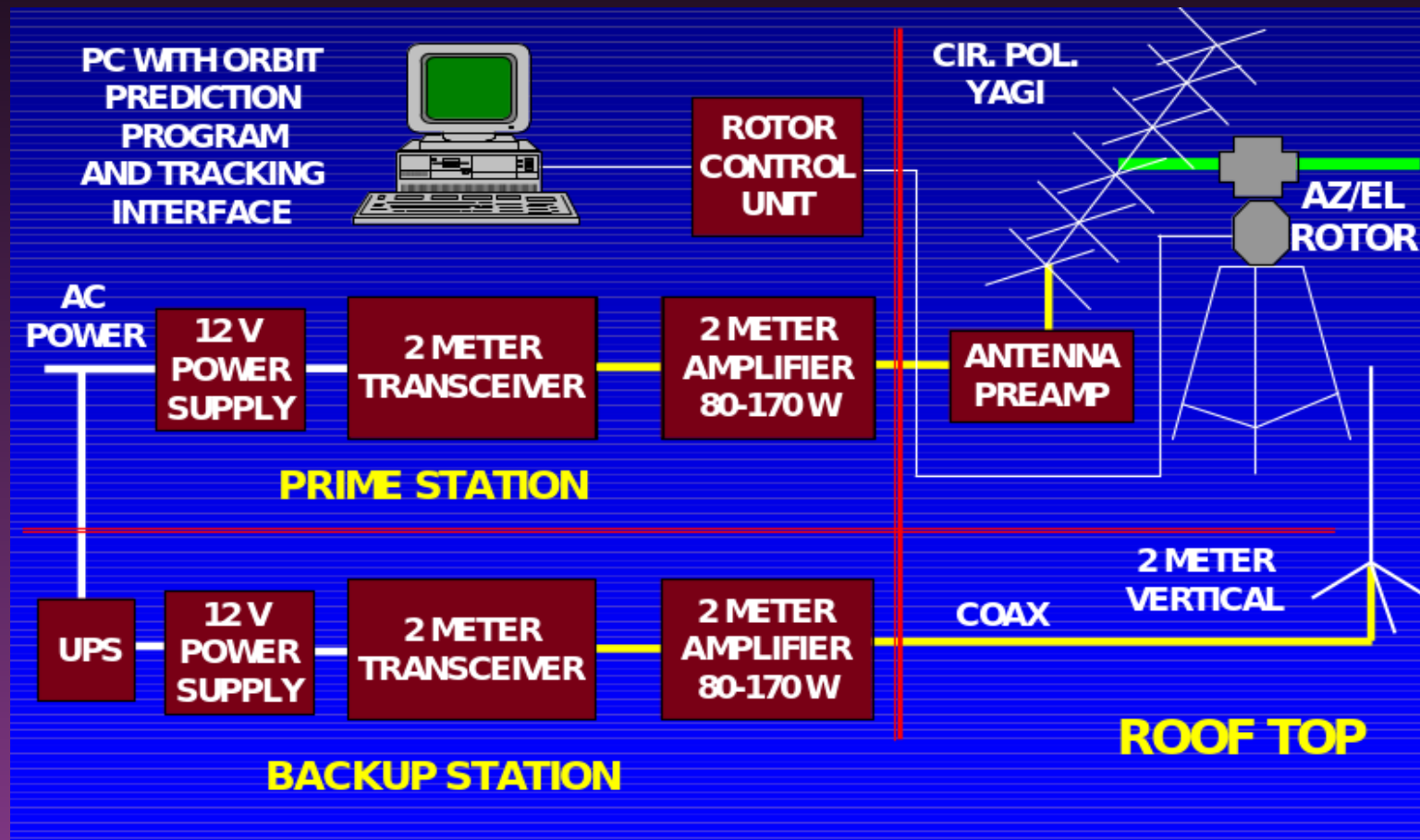
TH-D7 Handheld

O  
R

TM-D700 Mobile

WB4APR, Bob

# Maximum School Station



# Software Modems



**All modems and experimental waveforms  
processed by no-cost Sound Card  
Freeware/Shareware. Sound card audio  
connected to Transceiver**



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# Our Midshipmen go to SEA!



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**QUESTIONS??**